CALIFORNIA DIVISION OF MINES AND GEOLOGY

Fault Evaluation Report FER-44

February 3, 1978

1. Names of faults

Verdugo fault, Sycamore Canyon fault, and Eagle Rock fault.

2. Location of faults

These faults lie along the southwestern sides of Verdugo Mountain and the San Rafael Hills, within the cities of Los Angeles, Burbank, Glendale, and Pasadena. The area covered within this report lies within the Burbank and Pasadena 7½' quadrangles. See figure 1 for location.

3. Reason for evaluation

These faults are located within the 1977 study area of the 10-year program for fault evaluation.

4. List of references:
Literature

Baudino, F.J., 1934, The geology of the Glendale quadrangle, Los Angeles County, California. Unpublished masters thesis, University of Southern California, Los Angeles, California. 45 pages, 2 plates. Map scale 1:24,000.

Byer, J.W., 1975, Field trip guidebook, Sycamore Canyon fault, Verdugo fault, York Boulevard fault, Raymond fault, and Sierra Madre fault zone: Association of Engineering Geologists Publication, 68 p. No map.

(He is the only worker who provides descriptions and discussions of specific parts of the faults.)

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California State Water Rights Board, 1962, the City of Los Angeles vs. City of San Fernando: California State Water Rights Board Report of Referee no. 650079, v. 1, 258 p., v. 2, appendices and tables. Map scale 1:154,000.

(This is the only report that extends the Verdugo fault to the northwest beneath alluvium.)

Corbato, C.E., 1963, Bouguer gravity anomalies of the San Fernando Valley, California: University of California Publications in Geological Sciences, v. 46, no. 1, p. 1-32, 3 plates.

(His gravity work supports the existence of the northwestward continuation of the Verdugo fault.)

Dudley, P.H., Jr., 1954, Geology of the area adjacent to the Arroyo Seco Parkway, Los Angeles County, California: Unpublished masters thesis, University of California, Los Angeles, 84 p., 3 plates. Map scale 1:15,840.

(He maps, and gives some discussion of the Eagle Rock fault.)

Envicom Corporation, 1975, Seismic safety element technical report, City of Glendale. Unpublished report for City of Glendale, 110 p., 2 appendices, 1 plate. Map scale 1:24,000.

(Their mapping mostly compiled from the work of others.)

Jennings, C.W., 1975, Fault map of California with locations of volcanoes, thermal springs and thermal wells: California Division of Mines and Geology, California Geologic Data Map Series, Map no. 1. Scale 1:750,000.

Lamar, D.L., 1970, Geology of the Elysian Park-Repetto Hills area, Los Angeles County, California: California Division of Mines and Geology Special Report 101, 45 p., 2 plates. Map scale 1:24,000. (He provides the best discussion of the San Rafael fault and the eastern part of the Eagle Rock fault.)

Frankian, R.T., and Associates, 1968, Report of geologic and soil investigations, Verdugo Mountains development and conservation study, Glendale, California. Unpublished report for the City of Glendale, California, 61 p., 2 appendices. Map scale 1:4800.

Real, C.R., Parke, D.L., and Toppozada, T.R., 1977, Magnetic tape catalog of California earthquakes, 1900-1974: California Division of Mines and Geology.

Weldon, J.B., Jr., 1955, The Geology of the Pasadena-Eagle Rock area, Los Angeles County, California. Unpublished masters thesis, Claremont College, Claremont, California, 73 p., 2 plates. Map scale 1:24,000.

Aerial Photography

Source: Fairchild C-1394

Type: vertical, stereo, black and white.

Scale: 1:4,800.

Date flown: 2/25/31.

Coverage: Parts of the San Gabriel Range front in La Crescenta, and part of the southwestern side of Verdugo Mountain, Glendale.

Availability: Fairchild aerial photography collection, Geology Department, Whittier College, Whittier, California.

5. Summary of available data

The faults considered in this report will be discussed in three groups:

A. The Verdugo fault eastward to Verdugo Wash.

B. The Sycamore Canyon fault from Verdugo Wash northeasterly to the vicinity of the community of Linda Vista.

C. The Eagle Rock fault, between Verdugo Wash and the Arroyo Seco. Included with the Eagle Rock fault will be the various local branches including the Scholl Canyon and San Rafael faults.

A. Verdugo fault

This fault occurs along the southwestern border of Verdugo Mtn. The maps of R.T. Franklin and Associates (1968) and Envicom Corporation (1975) show the southeastern part of the fault zone within crystalline basement rock between Verdugo and Childs Canyon (figures 3a and 3b). They describe the faulting in this area as a northeast-dipping zone of crushed and broken rock. Byer (1975, p. 8) describes this part of the fault zone for his field trip stop number 3. Envicom Corporation (1975) also maps an inferred fault along this part of the mountain front that lies beneath alluvium immediately to the southwest of the lowest basement rock occurrences. Byer (1975, p. 10) mentions a "topographic rise" in the alluvial surface along this fault and cites some problems with upwelling groundwater in this area as further evidence for the existence of this fault trace.

To the northwest of Childs Canyon, California State Water Rights Board (1962) provides the only map of the Verdugo fault. They infer the fault (based on a groundwater barrier) extending to the northwest,

beneath the alluvium, and terminating just southwest of the Pacoima (the fault extends 3 miles farther to the northwest than shown on fig. 3b). Hills. They also state (in their Volume II, Appendix A) that the fault was observed to be exposed within Burbank:

> "It is plainly exposed on either side of a ravine for 50 to 75 feet; it dips 70 degrees south. Older reddish brown consolidated Quaternary gravelly sand is sharply down faulted against Basement Complex. Brecciation, gouge, and calcite vein material all occur in the fault. This fault extends under the alluvium along a line extending along the southern foot of the Verdugo Hills to the south of the Pacoima Hills, an outlier of the Verdugo block."

Envicom Corporation (1975, p. 36) states that they could not find that exposure during their study. They did, however, find what they believe to be another exposure of the fault in basement rock between Sunset Canyon and Strough Canyon. This is the same location as the field trip stop number 5 of Byer (1975, p. 12).

The existence of the inferred fault of California State Water Rights Board (1962) is supported by Corbato (1963, p. 16). His gravity study of the San Fernando Valley area showed a very steep gravity gradient along the same trend.

Most of the workers either imply or state that the Verdugo fault is a thrust or reverse fault, northeastern side upthrown. Envicom Corporation (1975, p. 36) states that the basement rock of Verdugo Mountain has been uplifted 3000 feet relative to the basement rock beneath the valley to the south.

Both R.T. Franklin and Associates (1968, p. VII-13) and Envicom Corporation (1975, p. 37) state that they found no evidence for "recent" or "Holocene" faulting along the Verdugo fault zone.

B. Sycamore Canion fault

This fault trends in an east-northeasterly direction through the central part of the San Rafael Hills. The best exposures are near the southwestern end. R.T. Frankian and Associates (1968, p. V-1) discuss a roadcut exposure at Avonoak Terrace, and Byer (1975, p. 6) discusses this same exposure for his field trip stop number 2. Byer (1975, p. 5, field trip stop #1) also discusses a good exposure of the fault in a roadcut on the new north-south-trending freeway that is being constructed through that area.

The map of Envicom Corporation (1975) shows the Sycamore Canyon fault curving to the northwest at its southwestern end and joining the southeastern end of the Verdugo fault (see figure 3a). This fault connection is inferred beneath Verdugo Wash. They do not state what their basis is for that interpretation; it may be speculative. To the northeast, no one has mapped the fault as far as the community of Linda Vista. Byer (1975, p. 5) states, "The fault zone narrows considerably to the northeast and the extension of the fault beyond the Chevy Chase Golf Course is not clear."

It is stated in several references that the fault dips 35 degrees N at the exposure on Avonoak Terrace, but no other mention of the attitude of the fault is given. R.T. Frankian and Associates (1968, p. V-1) state that, at the Avonoak Terrace exposure, the crystalline basement rock is thrust over "Quaternary terrace deposits." This is the only description that indicates the sense of movement along this fault -- northwestern side upthrown. This description is also the only one that indicates Pleistocene movement along this fault. Byer (1975, p. 6)

questions this exposure, however:

> Are the sediments exposed below the fault Quaternary Terrace deposits? Study the outcrop carefully. Notice the weathered granitic fragments surrounded by a coarse sandy matrix. Similar sediments occur within the Miocene Topanga formation. Does this exposure indicate only that the age of the Sycamore Canyon fault is Post Middle Miocene? (NOTE: An outcrop of the Sycamore Canyon fault east of here at Gladys Drive exposes undisturbed Quaternary Terrace deposits resting on the fault.)

Regarding recency of fault movement, R.T. Frankian and Associates (1968, p. VII-13) find no evidence for "recent" movement. Envicom Corporation (1975, p. 37) states that, based on the exposure at Avonoak Terrace, "... the fault was active within Quaternary geologic time, and can be considered potentially active."

C. Eagle Rock, Scholl Canyon, and San Rafael faults

Envicom Corporation (1975, p. 37) gives an excellent summary of these faults:

> These faults may be the southeast continuation of the Verdugo fault. The Eagle Rock fault forms the boundary between crystalline basement rocks to the north (mainly diorite) and steeply dipping Topanga Formation sedimentary rocks to the south. The fault is exposed in at least three places: It is a wide crushed zone at Patrician Way east of Eagle Rock, is seen in the Arroyo Seco, and in a cut of the Colorado Freeway where it dips 50 degrees north. Lamar (1970) suggests a minimum of 6000 feet of vertical separation on the Eagle Rock fault.
>
> The San Rafael fault merges with the Eagle Rock fault near the Arroyo Seco. The westward extension of the San Rafael fault appears to join the Scholl Canyon fault in Glendale, and then join the Verdugo fault under Verdugo Canyon. These are all reverse faults. The southeastern extension of these faults is not clear in southern Pasadena, but they either merge or are truncated by the Raymond Hill fault.
>
> There is no evidence to indicate that any of these three faults are active or potentially active other than the postulate that they are the southeastern extension of the Verdugo fault. Available geologic mapping, such as that by Lamar (1970), shows these faults as being overlain by, and as not cutting, Pleistocene units such as older alluvium and terrace deposits in Glendale and areas to the east. On this basis, these faults are considered inactive.

There is little else in the way of descriptions of these faults. Dudley (1954, p. 69) says that the Eagle Rock fault is marked by a gouge zone 25 to 50 feet thick, but he does not give any specific localities. He adds that the northern side of the fault has probably been upthrown at least 5000 feet. Dudley (1954, p. 69) and Weldon (1955, p. 57) both state that no alluvium is displaced by the Eagle Rock fault. Regarding the San Rafael fault, Lamar (1970, p. 39) states that a minimum of 1000 feet of vertical separation has occurred along that fault at the Arroyo Scco. He implies that the northern side is upthrown.

Seismicity

The "A" quality epicenter distribution data show several low-magnitude epicenters near the Verdugo fault. The "B" quality data show a crudely linear pattern of epicenters which trends west-northwest and lies about 4 to 6 km to the northeast of the faults considered in this report. No known historical earthquakes have been associated with any of these faults.

6. Interpretation of aerial photos

I studied Fairchild (1931) aerial photography of the Verdugo fault zone between Brockman and Childs Canyons, within the cities of Glendale and Burbank. This coverage includes part of the inferred fault, beneath alluvium, that Byer (1975, p. 10) discusses. I can see no topographic evidence of any faulting of the alluvium in that area in 1931. The area was partially urbanized at that time -- the streets were in, but only a few houses had been erected.

7. Field observations

None.

8. Conclusions

The descriptions of the Verdugo fault indicate that it is at best a broad zone of crushing and shearing in the basement rock. This applies to that portion of the fault that is shown on figures 3a and 3b as solid or dashed lines. The inferred part of the fault, to the northwest, is not known at the surface. The Sycamore Canyon fault, Eagle Rock fault, and other faults shown on figure 3a are at least, in part, well defined. None of the workers state or imply that any evidence for Holocene movement was observed for any of the faults considered in this study. Some of the workers make the specific statement that there has not been "Holocene" or "recent" faulting in this area.

I think that none of the faults considered herein meet our criteria for being "sufficiently active." The Verdugo fault does not meet our criteria for being "sufficiently well defined," and parts of the other faults may also fail to meet that requirement.

9. Recommendations

I recommend that no faults in this area be zoned.

10. Investigating geologist's name, and date:

Drew P. Smith

DREW P. SMITH
Geologist
February 3, 1978

I agree with the recommendations.
Elliott
3/1/78

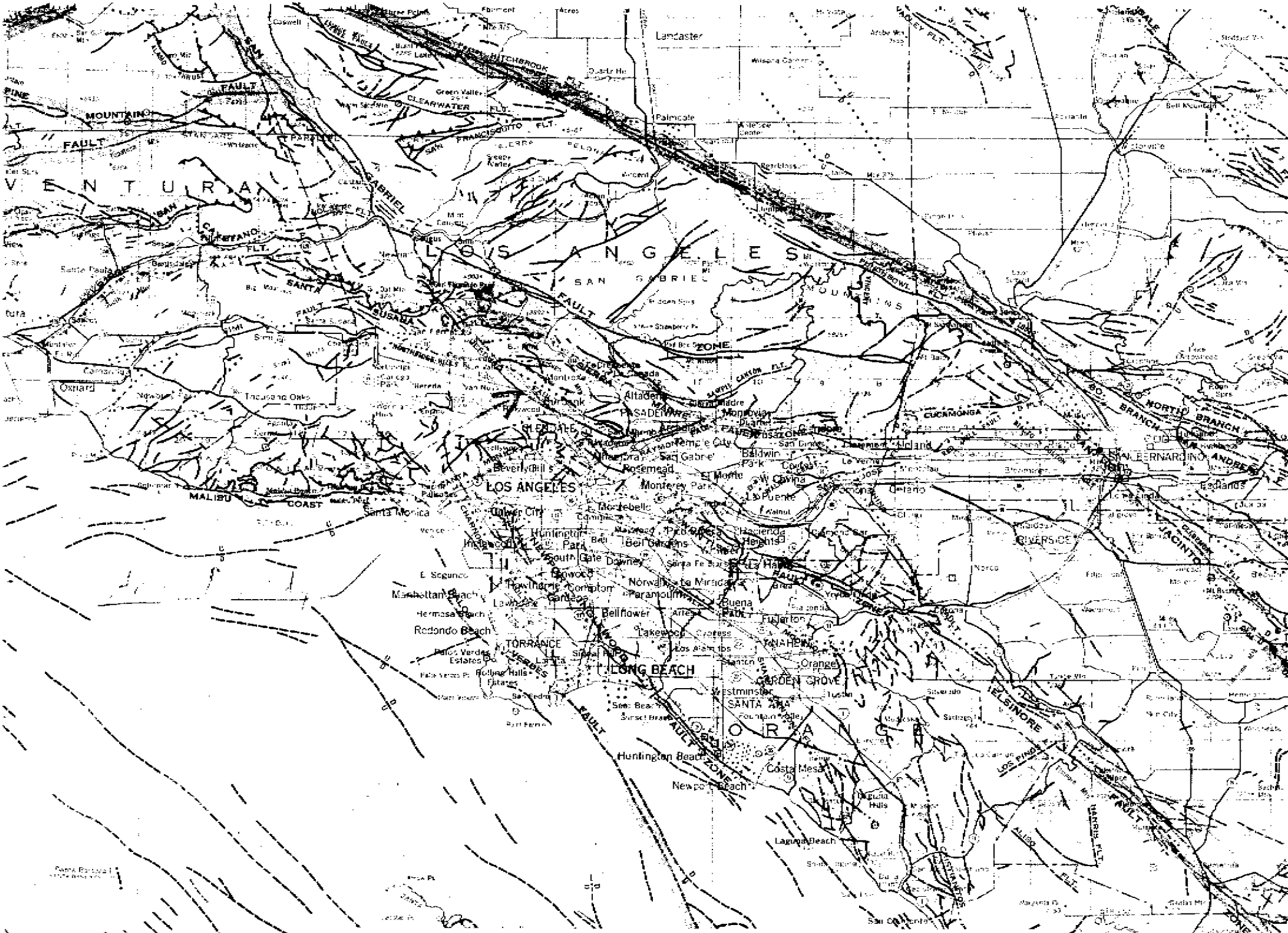
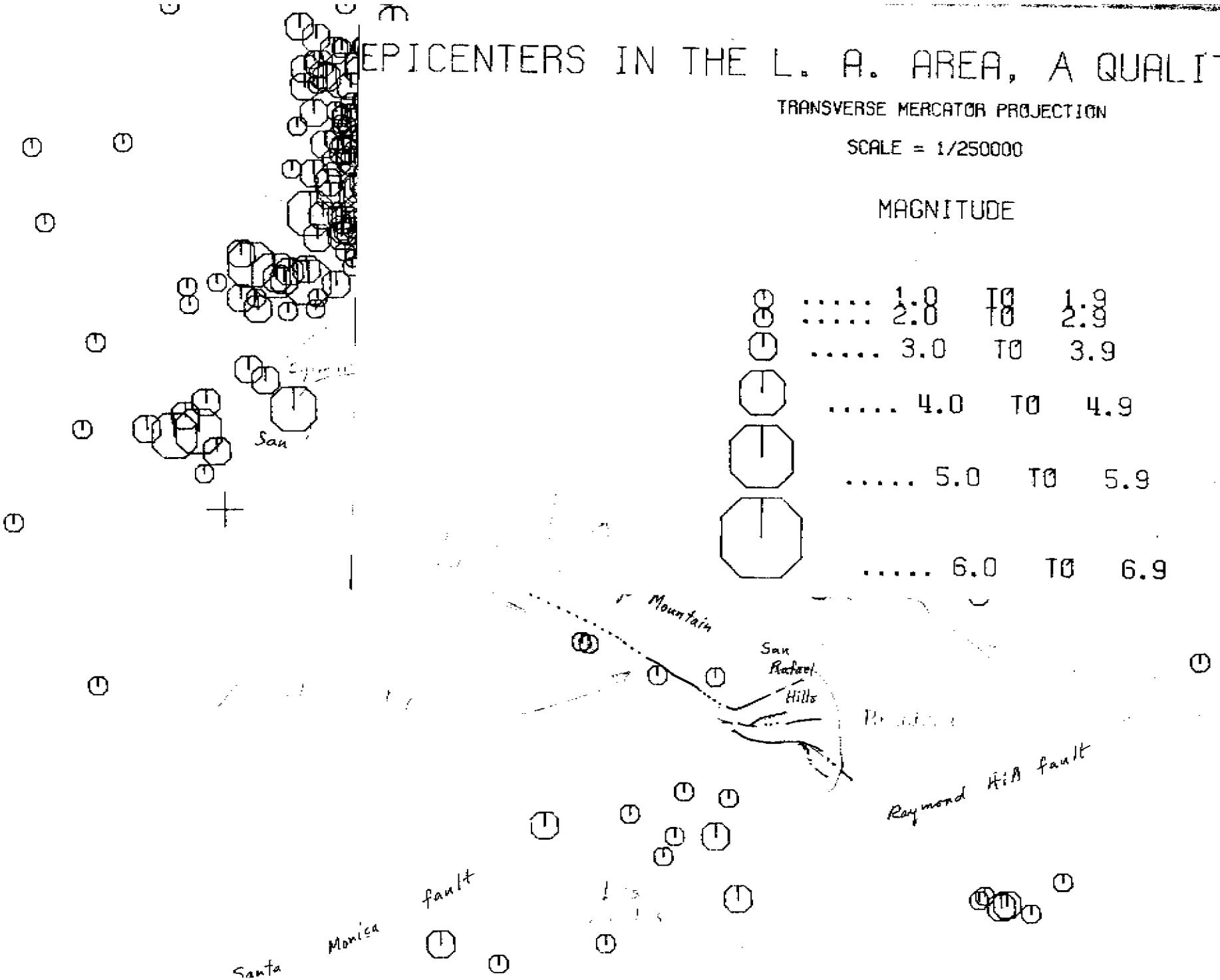
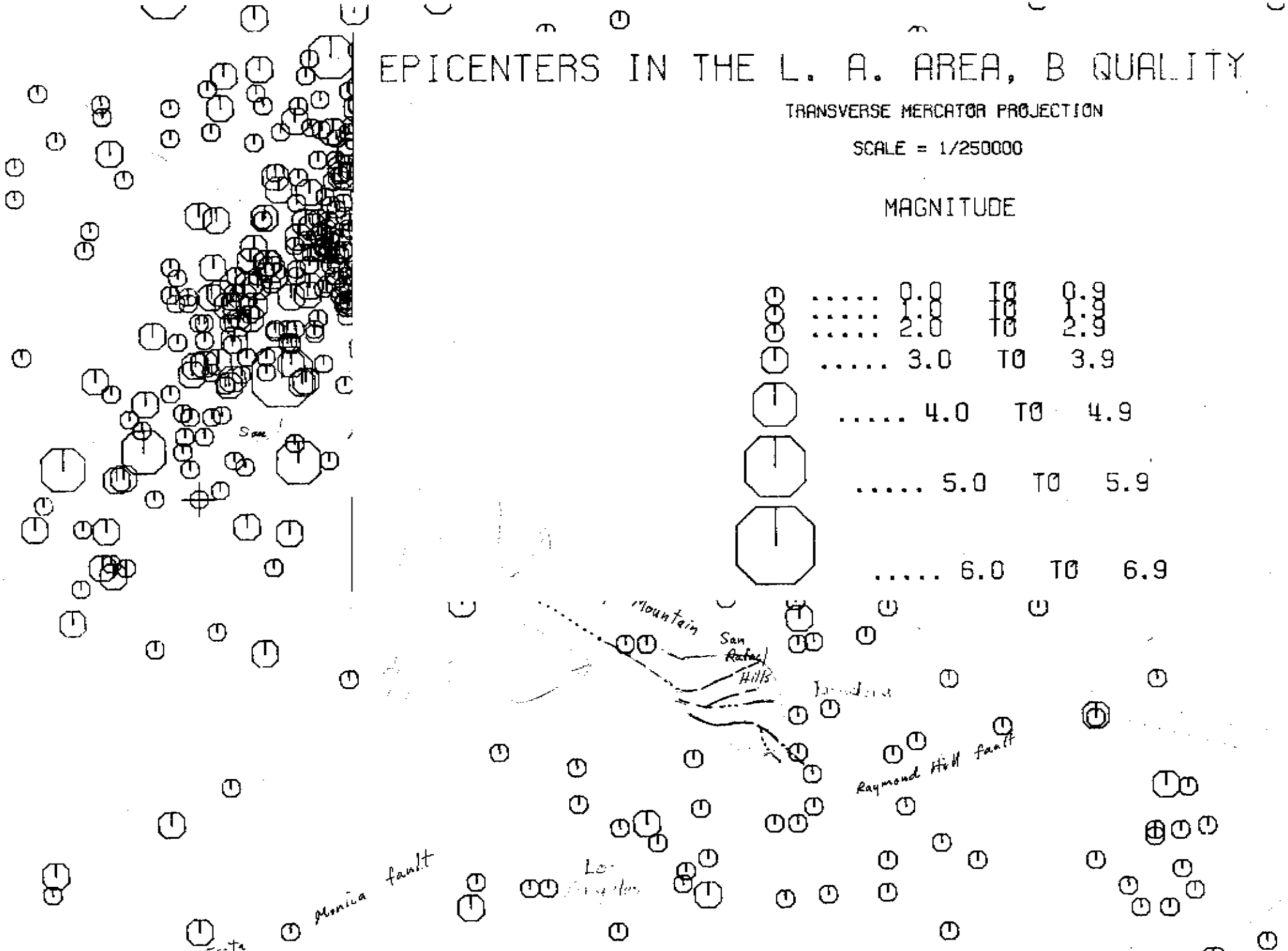


Figure 1. Index map showing locations of the Verdugo, Sycamore Canyon, and Eagle Rock faults. Map is modified from Jennings (1975).



FER 44 Figure 2a. Seismicity in the vicinity of the Verdugo, Sycamore Canyon, and Eagle Rock faults. "A" quality epicenter plots from Real and others (1977).



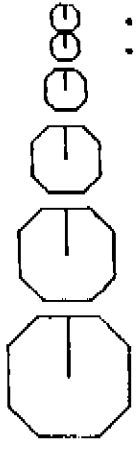
FER 44 Figure 2b. Seismicity in the vicinity of the Verdugo, Sycamore Canyon, and Eagle Rock faults. "B" quality epicenter plots from Real and others (1977).

EPICENTERS IN THE L. A. AREA, A QUALITY

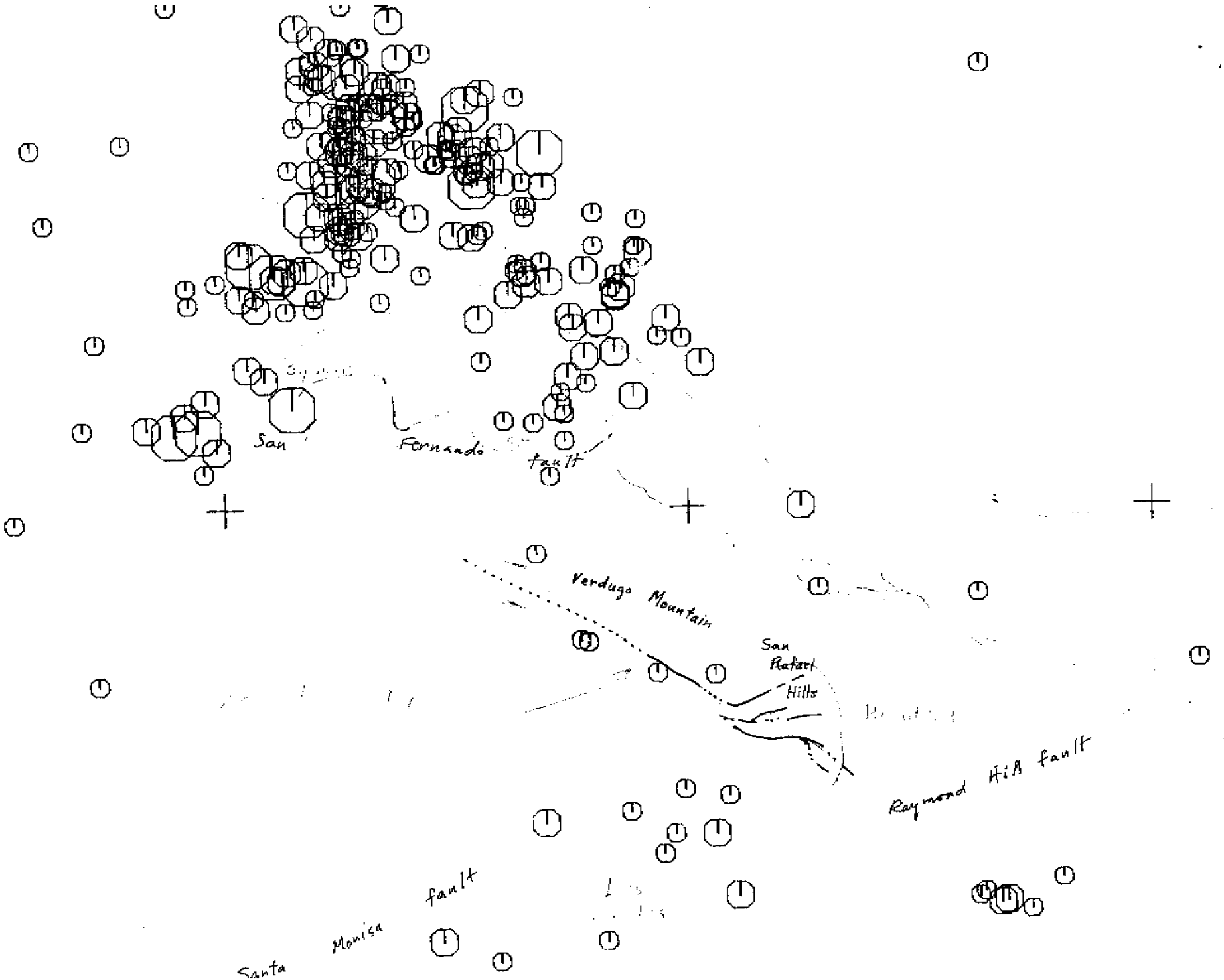
TRANSVERSE MERCATOR PROJECTION

SCALE = 1/250000

MAGNITUDE



..... 1.0 TO 1.9
..... 2.0 TO 2.9
..... 3.0 TO 3.9
..... 4.0 TO 4.9
..... 5.0 TO 5.9
..... 6.0 TO 6.9



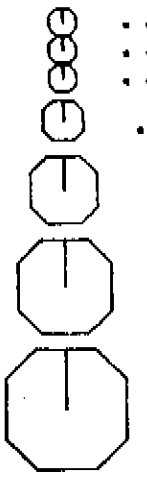
FER 44 Figure 2a. Seismicity in the vicinity of the Verdugo, Sycamore Canyon, and Eagle Rock faults. "A" quality epicenter plots from Real and others (1977).

EPICENTERS IN THE L. A. AREA, B QUALITY

TRANSVERSE MERCATOR PROJECTION

SCALE = 1/250000

MAGNITUDE



..... 0.0 TO 0.9

..... 1.0 TO 1.9

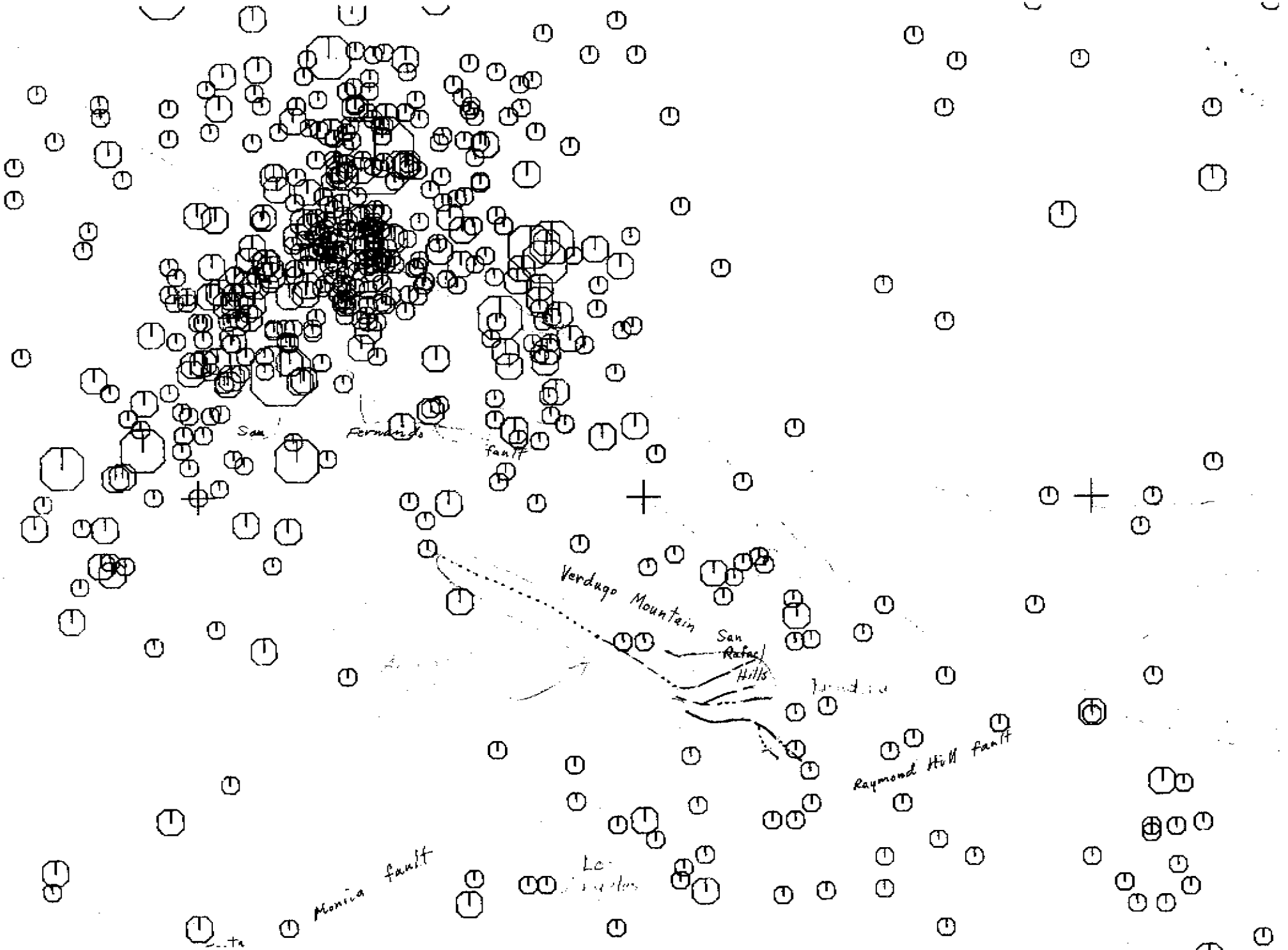
..... 2.0 TO 2.9

..... 3.0 TO 3.9

..... 4.0 TO 4.9

..... 5.0 TO 5.9

..... 6.0 TO 6.9



FER 44 Figure 2b. Seismicity in the vicinity of the Verdugo, Sycamore Canyon, and Eagle Rock faults. "B" quality epicenter plots from Real and others (1977).